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RELATIVE RIGHT TEMPORAL-LOBE THETA ACTIVITY CORRELATES WITH VINGIANO'S HEMISPHERIC QUOTIENT AND THE "SENSED PRESENCE" [1]

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Summary.—Measures of monopolar alpha and theta rhythm activity over the left and right temporal lobes were correlated with the subjects' hemisphericity (Vingiano) scores, temporal lobe signs, and concurrent subjective experiences during partial sensory deprivation. There was a positive association (*rho* = .49) between the scores for right hemisphericity and the relative amount of right/left theta rhythm but not right/left alpha rhythm activity. Significant intercorrelations between right hemisphericity, an history of ego-alien intrusions and experiences of a sensed presence, "detachment from the body," and fear during the recordings were noted. These results support the hypothesis that this class of mystical experiences is encouraged by hemispheric mismatch in temporal-lobe theta activity.

Persinger and Makarec (1991, 1992) have hypothesized that the "sensed presence," out-of-body experiences, and related forms of "mental diplopia" are the right-hemispheric homologues of the left-hemispheric sense of self. Conditions that facilitate intrusions of these right-hemispheric processes into the left hemisphere should increase the reporting of these experiences. We predicted that people who display more right than left temporal-lobe alpha and theta activity should endorse more psychometric indicators of right-hemispheric phenomenology and display more spontaneous experiences of ego-alien intrusions within a partial sensory deprived setting.

In the normal waking (beta frequency dominant) brain, more relative alpha or theta time should be associated with more electrical lability because of the expanded potential range in neuronal activity (whereas beta frequency EEG activity is associated with multiple small groups of cortical neurons discharging simultaneously, theta and alpha *rhythms* are associated with fewer, but much larger, groups of coherently discharging neurons whose patterns contain paroxysmal characteristics). This larger range would increase the probability of the overshoots and undershoots in electrical activity that would promote right-hemispheric intrusions into the left hemisphere where "awareness" of the two "selves" would occur. Intrusions would be encouraged by greater baseline electrical asymmetry between the two hemispheres. In the tradition of Jaynes (1976), a sudden breakdown in the asymmetry would facilitate left-hemispheric "awareness" of the right-hemispheric homologue.

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To test this hypothesis, 28 university students (15 women, 13 men) between the ages of 18 and 35 years old were randomly selected from a first-year psychology course. This size sample was selected because we assumed that at least 20% of the variance (an r of 0.45) must be accommodated between psychometric and electrical measures to have significant clinical value. The volunteers (2-point bonus) had been given Vingiano's (1989) Hemispheric Questionnaire two months before and the Personal Philosophy Inventory, PPI (Persinger & Makarec, 1987, 1993), an index of temporal-lobe signs, about one month previously.

Each subject sat in a comfortable chair housed within an acoustic chamber. Electrodes were attached by EC2 cream to the scalp over the left (T3) and right (T4) temporal lobes; each electrode was referenced to the appropriate ear. The subjects were instructed to sit quietly for 30 min. while wearing goggles (two halves of ping-pong balls) in the semidark (1 lux). During this time EEG recordings were completed by a Model P79 Grass instrument.

At the end of the session each subject was asked to complete an exit questionnaire of 20 items (Ruttan, Persinger, & Koren, 1990) designed to monitor components of classic mystical and paranormal experiences. The items refer to experiences of fear, out-of-body experiences, feeling a presence, inundation by dreams, etc. Normative data have been presented elsewhere (Ruttan, *et al.*, 1990).

The total numbers of seconds during which alpha *rhythms* and theta *rhythms* (visually conspicuous synchronous activity) were displayed over the left and right temporal lobes were determined (under blind conditions, i.e., the rater did not collect and was not aware of the psychometric data) by the first author for every 20 sec. (one paper length). This resulted in a total of 90 lines of data for each subject. These data were also converted into percentages of left and right theta and alpha time to visualize more easily the relative occurrence for this range of activity. Pearson correlations for the theta and alpha time between the left and right hemispheres were computed for each person using SPSS^X software on a VAX 2000 computer. In addition, the ratio of alpha time in the right hemisphere compared to the left one and the ratio of theta time in the right hemisphere compared to the left were calculated.

Since there were no statistically significant sex differences the population means and standard deviations (in parentheses) were computed. They were for left alpha time 47.8% (37.8), right alpha time 47.7% (36.3), left theta time 3.3% (8.3), right theta time 3.4% (8.4), ratio of right to left alpha 1.17% (.52), ratio of right to left theta 1.06% (.27), left-right alpha correlation [average $r = .45$ (.21)], and left-right theta correlation [average $r = .44$ (.26)]. The correlations (*rho*) between the left and right hemispheres for alpha and theta activity were .94 and .82, respectively. The correlations

between alpha and theta rhythm within the same hemisphere were .69 for the right and .71 for the left. However, the correlation between the ratio of right/left theta and the ratio of right/left alpha was not statistically significant (*rho* = −.30).

These coefficients plus the mean percentage of alpha and theta times for each hemisphere were then correlated with the psychometric and subjective experience measures. There were no statistically significant sex differences; the means and standard deviations were for Vingiano's Hemispheric Quotient .53 (.21), Factor I-PPI-sensory enhancement 37% (15), Factor 2-PPI-affective 55% (25), and Factor 3 (ego-alien intrusions) 22% (21). In addition, the specific cluster of items from the Personal Philosophy Inventory, called "sense of presence," was also calculated as 31% (32). The means and standard deviations for each of the 20 exit items were not significantly different from the measures in previous studies.

The more conservative Spearman correlation analyses (all $n = 28$) were first completed between the Hemispheric Quotient, the three temporal-lobe factors, the sensed presence cluster, and each of the 20 exit items. Right hemisphericity (higher scores on Vingiano's Hemispheric Quotient) was positively correlated (*rho* = .51, $p < 0.01$) only with Factor 2-affective (our right-hemispheric factor) and with Item 2 "I felt the presence of someone or something" (*rho* = .48). The affective factor was also correlated with this item (.47). The special cluster "presence" was only correlated (.47) with Item 6 (I felt detached from my body or left my body). None of the other exit items were significantly correlated with any of the hemispheric or temporal-lobe clusters.

Vingiano's Hemispheric Quotient was significantly correlated with only the percentage of theta rhythm activity over the right (*rho* = .43) but not the left (.12) temporal lobe and with the ratio of theta over the right/left lobe (.51); none of the alpha rhythm measures, including the right/left lobe ratio (−.05) were associated with this measure. Whereas ego-alien intrusion scores were correlated with right-hemispheric theta, our affective factor was associated (.57) only with the ratio of right/left alpha rhythm activity.

To simulate Vingiano's procedure for construct validity of the Hemispheric Quotient (Vingiano, 1989), subjects who scored < 0.4 on this questionnaire ($n = 9$) were compared to subjects who scored > 0.6 ($n = 8$). The latter group displayed significantly more (Kruskal-Wallis $\chi^2 = 6.39$ and 6.92, respectively) right-hemispheric theta time (3.3%) and right/left theta ratios (1.20) compared to the "left"-hemispheric group (0%, 0.99, respectively).

Responses on the ego-alien intrusion factor were positively correlated with right theta activity only (*rho* = .43). An history of "sensed presence" was strongly associated with right theta activity (.66) and the right/left hemispheric ratio (.41). Only one exit item was associated with any of the EEG

measures: Item 13 (I experienced terror or fear) was correlated with the ratio of right/left theta rhythms (.56).

To test our hypothesis specifically, principal component factor analysis was completed for these variables: Hemispheric Quotient, the sensory-enhancement factor, the affective factor, the ego-alien intrusion factor, relative right-/left-hemispheric theta time, the felt presence exit item, and the out-of-body exit item. After varimax rotation, the first factor (eigenvalue = 2.79, 39%) was loaded significantly ($r > .33$) by the Hemispheric Quotient (.62), right/left theta ratios (.37), Factor 2 (.74), Factor 3 ego-alien intrusion (.63), and sensing a presence during the recordings (.85). The second factor (eigenvalue = 1.35; 20%) was loaded by Vingiano's Hemispheric Quotient (.54), the theta ratio (.73), and the experience of self-detachment (.83) during the session.

Separate correlational analyses for each sex indicated that a major source of the significant associations was primarily the women. In fact, the amount of right theta activity was strongly associated with an history of sensed presence ($r = .66$, $p < 0.001$). However, it is important to note that both sexes displayed the positive correlation between the experience of fear within the chamber and amount of right-hemispheric theta activity (men = .60, women = .58).

Although the samples were small, we pursued the differential relationships between variables for each of the sexes (Persinger, 1991). The most consistent pattern differentiating the sexes is reflected by factor analyses (significant $r > 0.50$, considering the sample size) that included ratio of right/left alpha time, ratio of right/left theta time, Factor I (sensory enhancement) scores, Factor II (affective) scores, and Vingiano's hemisphericity scores. Whereas both men and women showed a coherent factor loaded by Vingiano's hemisphericity (.79, .52) and our "right hemispheric factor" (.93, .88), the right/left alpha ratio was negatively loaded on this factor (−.90) for men but positively loaded (.80) for women. Only the women displayed a single separate factor that was loaded by the right/left theta ratio (.93) and Vingiano's hemisphericity (.74).

The positive correlation between right temporal-lobe theta activity and right hemisphericity supports the construct validity of Vingiano's questionnaire. The intercorrelations between our "right hemispheric factor" and the Hemispheric Quotient and between both of these and an actual measure of experience during the EEG ("feeling a presence") indicates that both psychometric measures are related and people who display high scores are prone to these experiences. The propensity for theta rhythms (in this setting) to occur in brief bursts (1 to 2 sec.) is commensurate with the concept of the temporal-lobe transient (Persinger, 1983), the metaphor of intermittent interhemispheric coherence, and the phenomenological correlate of "sudden intrusion."

We interpret these results as support for the hypothesis that experiences of the dual self, such as Old Hag Experiences, out-of-body experiences, and even feelings of a cosmic presence, originate as sudden intrusions of right-hemispheric processes into the left hemisphere. Conditions that promote hemispheric mismatch (particularly more right-hemispheric theta activity), such as during mild hypoxia, surgery, near-death contingencies, right-hemispheric "dominance," and even nocturnal (diurnal) shifts, should increase the probability of this occurrence. Because they show greater interhemispheric coherence than men (Corsi-Cabrera, Herrera, & Malvido, 1989), women should be more prone to these experiences. The relative vulnerability of the right hemisphere may be related to its greater blood flow and metabolic demands.

The fact that only the concurrent item referring to terror or fear (a common correlate of enhanced right/left parahippocampal activity during panic attacks) was correlated with right/left theta dominance supports the role of such intrusiveness. We suggest that the affective (fear) component of intrusive experiences would be mediated through the anterior commissure (ventral portion of the temporal and adjacent limbic lobes) while the body-schema sensations ("detachment of self from body") would be mediated by the corpus callosum. The interpretation of these experiences would involve left-hemispheric linguistic processes and hence would be integrated into the person's belief systems and sense of self.

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